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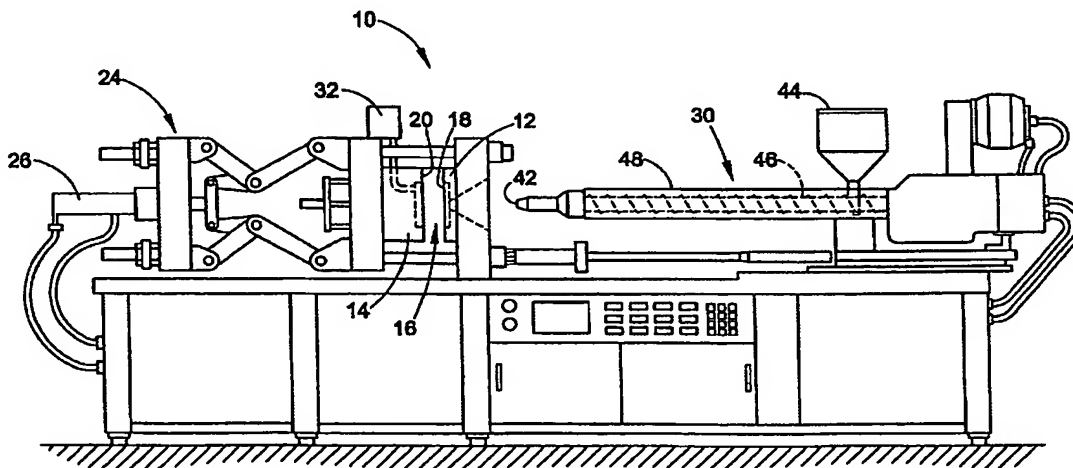
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**(54) Title:** PRESSURE AND TEMPERATURE GUIDANCE IN AN IN-MOLD COATING PROCESS



**(57) Abstract:** An in-mold coating method wherein the time at which a coating substrate is injected onto a surface of a molded substrate is determined by the internal mold temperature and/or pressure. By regulating the point at which the in-mold coating is injected based on the internal mold temperature and/or pressure, an operator can assure that the in-mold coating is injected when the surface of the molded substrate is in an ideal condition for in-mold coating adhesion.

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## AMENDED CLAIMS

**[Received by the International Bureau on 12 July 2004 (12.07.2004):  
original claims 1-18 replaced by amended claims 1-18 ( 4 pages)]**

1. A method for determining when to inject a coating for contacting a surface of a molded article in a mold in an in-mold coating process, the method comprising the steps of:

determining an internal mold pressure after a mold has been filled with a predetermined amount of a thermoplastic;

using a data collection means associated with a control apparatus, monitoring over time the internal mold pressure as said thermoplastic cools in the mold; and

determining from a change in the internal pressure that a surface of said thermoplastic has cooled to below its melt temperature.

2. A method according to claim 1, wherein said change in internal pressure is a reduction in pressure.

3. A method according to claim 1, wherein the internal pressure rises as said thermoplastic is injected into said mold, and subsequently decreases as said thermoplastic cools.

4. A method for in-mold coating a thermoplastic substrate, the method comprising the steps of:

Injecting a thermoplastic substrate into a closed mold, wherein at least one of an internal mold temperature and an internal mold pressure is monitored;

allowing a surface of said thermoplastic to cool to a point below its melting temperature to form a molded article;

injecting a coating into said closed mold such that said coating contacts at least a part of said surface of said thermoplastic, wherein said coating is injected at a point wherein at least one of said internal mold temperature and internal mold pressure is indicative of the point when said thermoplastic has cooled to below its melting temperature as determined by using a data collection means associated with a control apparatus.

5. A method according to claim 4, wherein said internal mold temperature and internal mold pressure is measured by a sensor.
6. A method according to claim 5, wherein a measurement determined by said sensor is relayed to the control apparatus controlling the injection of said coating.
7. A method for ensuring the quality of in-mold coated thermoplastic parts, the method comprising the steps of:
- a) manufacturing an in-mold coated thermoplastic part by molding a thermoplastic using a first set of process conditions in a closed mold to form a substrate and subsequently contacting an in-mold coating with said substrate by injecting an in-mold coating into said closed mold;
  - b) inspecting the coated thermoplastic part;
  - c) determining whether the molding of the thermoplastic should be optimized for failure to meet defined quality control standards;
  - d) optimizing the process conditions of the molding of the thermoplastic by adjusting one or more of injection volume, injection temperature, injection pressure, and molding pressure;
  - e) determining whether the coating of the substrate should be optimized for failure to meet defined quality control standards; and
  - f) optimizing the process conditions of the coating of the substrate by adjusting one or more of cure time, injection time, injection pressure, injection volume, injection temperature, or mold temperature at injection for said in-mold coating.
8. A method according to claim 7, wherein step c) is performed by determining whether said thermoplastic substrate exhibits at least one of voids and inadequate filling of said mold.
9. A method according to claim 7, wherein said first set of process conditions includes: one or more injection pressures for said thermoplastic, one

or more injection temperatures for said thermoplastic, one or more injection volumes for said thermoplastic, one or more injection times for said thermoset, one or more injection pressures for said thermoset, one or more injection volumes for said thermoset, and one or more cure times for said thermoset.

10. A method according to claim 7, wherein step e) is performed by at least one of determining whether said coating is intermingled with said substrate, determining whether a surface appearance of said coating is acceptable for a defined end use, and determining whether there is sufficient adhesion between said coating and said substrate.

11. A method according to claim 7, wherein said coating is injected into said mold at a point after said thermoplastic has cooled to a temperature below its melt temperature.

12. A method according to claim 11 wherein said point is determined by the monitoring of a temperature in said mold.

13. A method according to claim 11, wherein said point is determined by the monitoring of an internal pressure in said mold.

14. A method according to claim 7, wherein steps a) – f) are performed repeatedly until an in-mold coated thermoplastic part is produced that meets defined quality standards.

15. A method according to claim 7, wherein step f) is performed by at least one of 1) adjusting a time at which said in-mold coating is injected into said mold relative to a time at which the molding process is begun, and 2) adjusting a time at which said mold is opened and the coated part is removed from said mold relative to a time at which said in-mold coating is injected into said mold.

16. A method according to claim 7, wherein step f) is performed by adjusting an injection pressure for said in-mold coating.

17. A method according to claim 7, wherein values for one or more of said process conditions for said molding and coating steps are controlled and recorded by a control apparatus operatively associated with said mold.

18. A method according to claim 7, wherein said optimized process conditions are stored in a control apparatus associated with said mold and may be recalled for use in future molding processes.

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**AMENDED SHEET (ARTICLE 19)**

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/35305

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 B29C45/16 B29C37/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/039656 A1 (THOMPSON JOHN A ET AL) 4 April 2002 (2002-04-04) the whole document -----	1-6

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the International filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

5 April 2004

Date of mailing of the International search report

12 05. 2004

Name and mailing address of the ISA

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Authorized officer

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 03/35305

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-6

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6

A method for determining when to inject a coating.

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2. claims: 7-18

A method for ensuring the quality.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/35305

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002039656 A1	04-04-2002	US 6617033 B1	09-09-2003
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